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ABSTRACT

This review assesses the American College Test (ACT) Assessment and examines circumstances that can affect students' test outcomes. Understanding the ACT tests is important for using and interpreting test results appropriately. The ACT subtests incorporate both aptitude and achievement measures. The content scope and structure, and limitations of the English Usage Test, the Mathematics Usage Test, the Social Studies Reading Test, and the Natural Science Reading Test are described. Literature pertaining to the ACT validity as a predictor of student college outcomes is reviewed. Other student factors affecting test performance--such as test anxiety, test format, cognitive level, motivation, reading ability, and content familiarity--are described. A student/teacher packet developed by the National Association of Secondary School Principals to prepare students for the ACT is discussed. Combining test wiseness with instruction in test content can result in score increases. Stages for implementing an action oriented program for reversing test score decline are suggested. (BS)

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THE ACT ASSESSMENT

IMPLICATIONS OF RECENT RESEARCH

TM 840 539

This paper was authored by Mary O'Hearn, Secondary Language Arts Consultant, at the request of James L. Clor, Director of Student Services Department, Warren Consolidated Schools, April, 1984

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INTRODUCTION

Michigan colleges require American College Test Assessment scores from their entering freshmen. The original purpose for the ACT testing program founded in 1959 was to assist colleges to better admit, counsel, and place their entering freshmen.[1] Although today's colleges utilize student scores for these reasons, other people sometimes isolate the scores from this original context. For instance, the State of Michigan bases student aid monies on the ACT score. Without a thorough understanding of the ACT test, reactions to student scores per se may engender confusion and inappropriate conclusions. Extensive study and research has been done in order to objectively assess the test itself and to examine further into circumstances that can affect the students' test outcomes.

The findings presented in this paper derive from three areas. Summaries of ACT research up to 1977 were presented at a recent WISD conference sponsored by the National Association of Secondary School Principals. Although this research was valuable, additional and recent studies had contributed further information about student scores. To obtain this newer information, Dick Palmer, MISD librarian, and I initiated a complete ERIC search of ACT studies beyond 1977. Using these ERIC computer cites, I incorporated in this paper all relevant information from those sources available in the MISD Archives, together with the NASSP Conference findings, and interviews with college instructors. All these sources are cited in the Bibliography.

The ACT's History, Format and Content

The four ACT sub tests, English Usage, Mathematics Usage, Social Studies Reading, and Natural Sciences Reading are an outgrowth of the Iowa Tests of Educational Development. These ACT tests attempt to incorporate both aptitude and achievement measures. They contain subject matter content similar to achievement tests, in which questions are posed in formats designed to correspond with ability development, but they also require general reasoning and use of new information similar to aptitude tests' use of novel item formats requiring a broad kind of reasoning.[2] Furthermore, the ACT test items claim to incorporate samples from each of the Bloom's Taxonomy six categories of cognitive domain, namely:

1. knowledge
2. comprehension
3. application
4. analysis
5. synthesis
6. evaluation[3]

An examination of the format and content of the ACT's four tests presages both an analysis of the student's resultant scores, and explanations for interpreting the correlation between the student scores with various factors that influence the scores reliability.

> The arithmetic average of the scores on these four tests in the ACT Composite score, which is often used as a measure of overall academic ability.
>
> ACT test scores are reported on a standard scale that ranges from 1 to 36. On this scale, a student's true score is usually within two score points on either side of the score reported for each of the four tests and within one point on either side of the reported ACT Composite score.[4]

In addition, students tested report the last grade received prior to the senior high school year of each of these four subject areas. The combination of the high school grades with the ACT scores provides another measure substantiating academic ability.[5]

English Usage Test

The English Usage test proports to measure students' understanding and use of the basic elements of correct and effective writing. A 75-item 40 minute timed test, it contains several prose passages with certain portions underlined and numbered. For each underlined portion, the test provides four alternatives for possible correctness. The tested items included usage, phraseology, style, and organization, with greater weight accorded clear and effective expression and analysis of forms of expression over that of outright rote recall of grammar rules.[6] The content of the English Usage Test contains the following distribution:

> Grammar and punctuation: This includes punctuation and graphic conventions usage in agreement, verb forms, adjectives and adverbs, pronouns and their antecedents, and nouns.
>
> Sentence structure: This includes relation between clauses, parallelism, placement of modifiers, and predication and shifted constructions.
>
> Diction: Under this rubric are items concerned with word choice and idioms, figurative language, and economical writing.
>
> Logic and organization: Included here are logical organization of ideas, the elimination of inappropriate ideas and statements, proper wording of transitions, paragraphing, and appropriate conclusions.

English Usage Content Area	Proportion of Test	No. of Items
Grammar and Punctuation	.35	26
Sentence Structure	.25	19
Diction	.35	26
Logic and Organization	.05	4
Total	1.00	75 [7]

Because the test is weighted exclusively toward standard English usage, the English Usage test score should not be used to "(i)ndicate actual participation in writing activities, such as those measured by the ACT out-of-class accomplishment scales."[8] This test also

omits other aspects of an English curriculum, e.g. literature and speech, and cannot justifiably be considered as an indicator of general English ability.[9]

Mathematics Usage Test

The Mathematics Usage Test, a 40-item 50 minute timed test, measures mathematical reasoning ability and emphasizes solutions to practical quantitative problems. It contains a sampling of mathematical techniques rather than the assessing of strict memorization of formulas, knowledge of techniques, or computational skills.[10]

The content of the Mathematics Usage Test contains the following distribution:

> Arithmetic and algebraic reasoning: These problems are word problems about practical situations in which algebraic and/or arithmetical reasoning is required. The problems require the student to interpret the question and find an approach to its solution. Some of the problems may require only advanced arithmetic for solution while others call for algebraic approaches.
>
> Arithmetic and algebraic operations: In these problems, operations to be performed are explicitly described in the problem and the student must complete the designated operation. These problems include manipulation of fractions and decimals, operations with signed numbers, addition, subtraction, multiplication, and division of polynomials, solution of linear equations in one unknown, and manipulation of algebraic fractions.
>
> Advanced algebra: These problems include dependence and variations of quantities related by given formulas arithmetic and geometric series, solution and simultaneous equations, graphs of equations, inequalities, logarithmic principles, exponents, radicals, roots of equations, factoring and dividing polynomials, solution of quadratic equations.
>
> Geometry: Topics include mensuration of lines and plane surface, properties of polygons, angular relationships involving parallel lines and polygons, relationships involving circles and properties of circles, loci, solid geometry, trigonometric

principles, and the Pythagorean theorem. Both formal and applied problems are included under this category with most being formal.

Miscellaneous. This category includes problems in set theory, probability, logic, properties of numbers (prime, rational), and bases of number systems.

Mathematics Content Area	Proportion of Test	No. of Items
Arithmetic and Algebraic Reasoning	.35	14
Arithmetic and Algebraic Operations	.15	6
Advanced Algebra	.20	8
Geometry	.20	8
Miscellaneous	.10	4
Total - -	1.00	40

11

Implications that bear on an interpretation of the math score include the test's emphasis on reasoning and application. Because reading ability is also required, the test is not a pure non verbal quantitative measurement.[12]

Social Studies Reading Test

The Social Studies Reading Test, a 52-item 35 minute timed test, measures evaluative reasoning and problem-solving skills required in the social studies areas. Approximately 70% of the test items are passage related, while 30% require general background knowledge from high school social studies courses.[13] However, the reading related questions go beyond the Bloom's Taxonomy level of comprehension and employ the highest reading/thinking levels, namely, analysis, synthesis and evaluation.[14]

The content of the Social Studies Reading Test contains the following distribution:

Social Studies Area	Inference Items (Proportion of Test)	Inference Items (No. of Items)	Information Items (Proportion of Test)	Information Items (No. of Items)	Total (Proportion of Test)	Total (No. of Items)
European & Ancient History	.14	7	.06	3	.20	10
Government & American History	.28	15	.12	6	.40	21
Current Social Issues, Soc., Eco., etc.	.28	15	.12	7	.40	21
Total -	.70	37	.20	15	1.00	52

15

Because students' social studies programs include varying course content, the test passages were not tied to a presumed uniform high school curricula. The heavy emphasis on reading ability applied to the actual test passage content attempts to overcome course diversity. This weighting towards reading ability is further rationalized in that college social science courses also require critical, evaluative and inferential reading skills. Therefore, the test does not systematically sample students' factual knowledge about social studies areas; it is not, simply, a social studies test , divorced from reading ability.[16]

Natural Science Reading Test

The Natural Sciences Reading Test, a 52-item, 35 minute timed test, measures critical reasoning and problem solving skills required in the natural sciences. Similar to the Social Studies test, 30% of the test items rely on the students' specific background information in biology (48%), chemistry (23%), and other science areas (29%). The remaining 70% involves passage related reading questions. These questions, as distinguished from those in the social studies section which emphasized the highest reading/thinking skills, rely more on understanding and interpreting a description of a scientific experiment, and then making appropriate inferences or deductions drawn from that experiment.[17]

The Natural Science Reading Test content contains the following distribution:

	Inference Items		Information Items		Total	
Science	(Proportion of Test)	(No. of Items)	(Proportion of Test)	(No. of Items)	(Proportion of Test)	(No. of Items)
Biology	.36	19	.12	6	.48	25
Chemistry	.17	9	.06	3	.23	12
Physics, Geology, Astronomy, and General Science	.17	9	.12	6	.29	15
Total -	.70	37	.30	15	1.00	52

> The test emphasizes the content covered in high school science curricula (Biology, Chemistry, Physics, etc.), scientific experimentation, and the "(l)ogic of science." In general the items involve inferences or deductions from passages, graphs, or experimental data; the application of principles, and the evaluation of experimental design and procedures.[18]

Shortcomings of this test stem from the heavy emphasis on reading ability without consideration of the student's competence in performing laboratory experiments. Scientific ingenuity, the "(c)reative aspects of scientific endeavor" is nowhere directly assessed in the test. Therefore, the test is deficient as a measure of scientific ability.[19] In fact, students "(w)ith little scientific background or interest but high critical scientific thinking ability may score high on the test."[20]

Validity of ACT Test Scores And Variables Affecting Student Scores

Despite the tests' shortcomings, substantial evidence nonetheless supports the validity of the ACT scores. "The ACT has been shown to be a fairly effective predictor of relevant college outcomes for students of different social classes attending a wide variety of postsecondary institutions."[21]

However, the element of high school grades is also significant.

> As is frequently the case, high school grades predicted college freshman grades better than either the ACT or the SAT.[22]

The composite ACT score along with the high school grade average is the best predictor of freshman college success and is as "(s)atisfactory as the state of art of test measurement currently permits. Its predictive accuracy is in the 70% range."[23]

Recent research, in attempting to shed light on student ACT scores, has carefully analyzed the ACT sub tests, and has posited correlation with certain student variables. In regard to the English Usage test, as noted earlier, no attempt is made to assess student's knowledge of literature, nor is an actual writing sample utilized. A study combining writing sample grades with the ACT English usage score revealed that "(a)pproximately a quarter of the students would have been placed differently" had the college used either the ACT score or the writing sample alone.[24]

Elements measured in this writing sample were:

> Mechanics
> Sentence Structure
> Structure of Paper
> Development of Paper
> Style, Clarity, Diction
> Content and Ideas[25]

It is obvious that the elements of structure and development of the paper, and its content and ideas go beyond those items measured in the ACT English Usage Test. Nonetheless, another theory, attempting to explain the high predictive correlation between the ACT English usage score and the Freshman College Composition grade, suggests that the measured elements of the ACT English usage tests comprise part of a subset of language skills necessary for competence in writing. Indeed,

> Subskills such as word syllable sense, vocabulary, and spelling may function as threshold variables for writing tasks. Combined with measures of English usage, and word-level tests they add precision as well as diagnostic information for the placement of freshmen into composition classes designed to meet their different instructional needs. Whenever costs of holistic scoring (for writing samples) are prohibitive or whenever such measures are otherwise undesirable, these test batteries should help to identify and to provide diagnostic information about students who are deficient in writing.[26]

This theory further suggested that high mental abilities "(l)ose discriminating power in the prediction of overall grade point average" when these language sub skills are lacking. "In other words, language subskills below a certain threshold of mastery are disabling to competence in writing."[27]

However, another view point looks rather to the element of the grading procedures of college composition instructors, as a clue to the ACT's strong predicative validity.[28] Correspondence between the ACT usage score and the freshman composition class may occur because "(M)any college instructors emphasize usage and structure over content and originality", suggests Dr. Dan Fader, University of Michigan Composition Board. "The emphasis on fluency from early on should be relaxed extension of the student's speaking voice, but instruction also should incorporate correctness."[29]

Bill F. Fowler, Iowa State University instructor and author of "The Comparative Validities of Differential Placement Measures for College Composition Courses", (see #21 Bibliobraphy) asserted that, "(C)orrectness should be provided as needed along with the student's natural, expressive writing modes, in order to attain a balance between written fluency and correctness (in using standard English)." To overcome deficiencies in English usage, or in other words, to compensate if a student's background lacks standard English proficiency, it is generally agreed that the method not to be used is that of teaching grammar/usage rules in isolation. In fact, such methodology is "(p)robably detrimental."[30] Bill Fowler noted that differences in student's language background though, "(t)hwart instruction (in standard English usage) and the home background is difficult to overcome." The element of home background influence on English usage ability is supported by other research findings.[31]

> Finally, an examination of the content of the ACT Usage Test has implications for generalizations to students of non-English or non-standard English

> cultural bakcgrounds. The concern with English usage on the test may be expected to put such students at a serious disadvantage. Such a disadvantage may be appropriate where knowledge about the student's present ability to use standard (even academic) English is required (e.g. for placement in remedial courses.)[32]

Significantly, Bill Fowler had also noted that although the ACT emphasis on standard English constituted a bias ("a negative socio-economic bias"), the instructional attempts to overcome these language deficiencies can "(m)ove the student into the cultural mainstream," whereas, should such instruction be "(i)nept or inappropriate" we are creating for such a student "(a) permanent isolation." In fact, use of standard English serves to "(m)aximize the student's later job mobility."

The ACT Mathematics Usage Test was originally designed by E.F. Lindguist, Cofounder of ACT, to test not "(j)ust what students know in math, but how well they can apply their knowledge in new context."[33] This test measures the student's mathematical reasoning ability in a "(q)uantitative context, rather than memorization of formulas, knowledge of techniques, or computational skill."[34]

The ACT conducts periodic surveys of high school and college math curricula, and analyzes, evaluates and revises this test each year. High school and college teachers from throughout the country are used to construct the test items. These teachers are recommended by math chairpersons in high schools, colleges, and universities; by math experts; and by educational writers on mathematics.[35]

However, the scoring mechanism of the English Usage Test and the Mathematics Usage Test differs widely. In the verbal section, 0 correct is scored as 200, whereas 0 correct in the math section scores 260; thus the math scores will never be equal to that of the verbal unless the student is extremely weak in math. A perfect score in English Usage (see The ACT Assessment Sample Test Booklet 8324C, P. 37) reaches 33 as the top measure in the standard score scale as distinguished from math's top score of 36. In addition, the verbal skills measured are much more demanding and complicated than

those in the math area. Because the norms and the two exams are so different, they cannot be compared.[36]

In the social studies usage tests, the reading skills employ the highest thinking levels (Bloom's Taxonomy, "(a)nalysis, synthesis, evaluation"); therefore, a clearer understanding of these skills was researched. This study compared ACT Test scores with the student's Piagetian Cognitive Level. The cognitive thinking level includes all six steps of Bloom's Taxonomy.

> The knowledge category, the lowest level of learning outcomes, includes recall of specific facts and appropriate information. Comprehension, the next highest level, involves the ability to grasp the meaning of material and represents the lowest level of understanding. The application category requires a higher level of understanding than those under comprehension and refers to the ability to use learned materials in new and concrete situations. The analysis category, requiring an understanding of both the content and structural form of the material, demands an ability to break material into component parts so its organizational structure can be understood.
>
> As these categories of learning outcomes increase in complexity, so the level of cognitive functioning may also need to increase.[37]

In cognitive development the individual eventually transcends concrete operations and attains the level of formal thinking. The concrete thinking level is limited to concrete, empirical data, e.g. the acquisition of facts. This thinking level is dominated by reality. The formal thinking stage is dominated by possibility; a student is able to apply facts to a new situation or to analyze their logical placement in a larger milieu. Research with diverse populations indicates that students today reach formal thought later than those tested 30 years ago. Formerly the transition occurred at adolescence (12 to 15 years); it now is delayed from 15 to 20 years. [38]

The reasons for this slower rate of intellectual development were probed.

> Inhelder and Piaget (1958) assert that the growth of formal thinking is influenced as much by social factors as by maturation. Education as a social force can accelerate or retard this growth. If This is so, then it is of considerable importance to know the kinds of educational activities adolescents and young adults are required to perform.[39]

Conclusions resulting from measuring this college sample groups' Piagetian level were mixed. The variable of class showed no significant difference, nor was age a significant factor.[41] However, a "(m)oderate but significant correlation was found in the relationships of Piagetian score to ACT total score."[42]

> The conclusion could be drawn that students learn basic facts and are capable of lower-level comprehension whether or not they are formal thinkers. Tasks requiring higher-level analyses and reasoning, however, are better accomplished by formal thinkers.[43]

In light of today's changing contemporary world, the importance of assisting students to possess the cognitive strategies that will enable them to seek out and acquire knowledge for themselves acquires greater significance than transmitting bodies of scientific or technical knowledge.[40]

Other variables also acquire relevance. The element of motivation was postulated as a factor which is possibly of greater importance even than the student's cognitive level.[44] Student self concept and "(o)ther personality variables, as well as attitudinal variables" may also contribute as student predictors for academic success.[45] Variables of race and sex are insignificant.[46]

Still another variable accounting for student academic success is persistence . . ."(a)chievement motivation was certainly related to academic persistence and may be also related to academic achievement . . . whatever the impact of achievement motivation on academic achievement, the relationship is indirectly determined through differences in student persistence."[48]

The ACT composite score, however, does predict academic success with greater validity than most other type tests, "(f)or the first three years of college."[49] It is noteworthy, however, that all four ACT scores steadily increased as family income increased.[50]

Still another influence that may obscure assessment of student performance is student anxiety over taking the test.

> Sarnacki (1979), in his review of factors affecting test performance in the cognitive domain, suggests that familiarity with the arrangement of the items in a test may reduce one's test anxiety.[51]
>
> Elements of test arrangements include:
>
> - presentation of the individual questions e.g. item arrangement (easy - hard, hard - easy, uniform, spiral cyclical, and random)
> - specificity of test directions
> - speed[52]

Although knowledge of the item arrangement per se did not significantly reduce anxiety, familiarity with the test, practice in taking the tests and coaching of the weak areas can result in higher scores.[53] Thus, test wiseness can offset the negative impact of student test-taking anxiety.

Because of the ACT's heavy emphasis on reading, experts hava analyzed test items to determine which specific reading skills were employed. There was general disagreement over exactly which skills were being measured. However, each of the four subtests used some evaluative questioning.[54] The reading level of the tests themselves range from grade 11 to 2nd year college.[55] And, as has been noted already, the social studies reading test is weighted toward the skills of analysis, synthesis, evaluation.

The link between reading ability and ACT Social Studies and Natural Science test scores needs further study. A new definition of reading has been formed to include as a variable to reader performance the influence of the "(r)eader's familiarity with the topic, interest in and purpose for reading, and the content and structure of the text."[56] The prior definition of reading had viewed reading as a series of skills in a sequential ordering (literal, inferential, applied comprehension.) This viewpoint "(n)o longer adequately reflects our knowledge of reading."[57] Significant advances in anthropology, cognitive psychology, education, linquisites, and sociology have now broadened our understanding of the reading process.

> Recent research holds that reading is a dynamic process that involves the reader's ability to construct meaning through the interaction between information suggested by the written language and the reader's existing knowledge.[58]

From this, it can be inferred that students whose curricula contained the content that is supplied in the ACT reading passages (Social Studies, Natural Science) have an additional strength and advantage over the student who relies exclusively on the passage information itself. However, test wiseness cautions an awareness of how some test item questions are couched. For instance, a student may disagree with the passage content and thus choose a wrong answer based on what they believe. Test wiseness would dictate that certain kinds of questions have stems beginning with "(a)ccording to the passage", which should alert the student to rely only on that passage's date.[59]

NASSP ACT Materials

The National Association of Secondary School Principals has prepared a student/teacher packet to prepare the students for the ACT test-taking. The NASSP recommends use of the materials twice monthly with an additional homework hour from September thorugh April, just prior to 11th graders taking the test in May. A long lapse between the actual

ACT test taking, and the use of these materials is not beneficial, nor is short term coaching. However, combining test wiseness with instruction in test content can result in 47 point increases.[60] These NASSP materials will be published in the summer of 1984.

If an action - oriented program is desired for reversing test score decline, several stages are suggested for implementation. They can include:

1. A task force of committed principals, instructional personnel, and teachers to develop broad program objectives, procedures, time lines, and evaluation procedures.

2. An intensive in-service program for teachers which would include:

   a. inventory of materials needed
   b. a limited number of 'during the day' large group instruction sessions
   c. classroom demonstrations
   d. observations of the classroom implementation
   e. evaluation of the program[61]

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